

# CSE574 Introduction to Machine Learning

## Support Vector Machine

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## 1 Alternative View of Logistic Regression

## 2 Support Vector Machine

# Alternative View of Logistic Regression

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Introduction  
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Learning

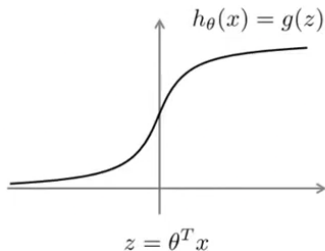
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Alternative  
View of  
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Regression

Support  
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A quick review:  $h_{\theta}(x) = \frac{1}{1+e^{-\theta^T x}}$

- if  $y = 1$ , we want  $h_{\theta}(x) \approx 1$ ,  
 $\theta^T x \gg 0$
- if  $y = 0$ , we want  $h_{\theta}(x) \approx 0$ ,  
 $\theta^T x \ll 0$

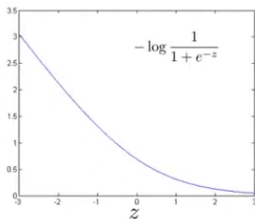


The cost of a single example:

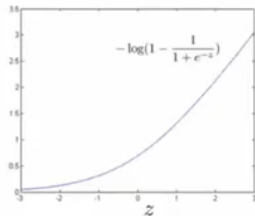
$$\begin{aligned} & - (y \log h_{\theta}(x) + (1 - y) \log (1 - h_{\theta}(x))) \\ &= - y \log \frac{1}{1 + e^{-\theta^T x}} - (1 - y) \log \left( 1 - \frac{1}{1 + e^{-\theta^T x}} \right) \end{aligned}$$

$$-y \log \frac{1}{1 + e^{-\theta^T x}} - (1 - y) \log \left( 1 - \frac{1}{1 + e^{-\theta^T x}} \right)$$

if  $y = 1$  (want  $\theta^T x \gg 0$ )



if  $y = 0$  (want  $\theta^T x \ll 0$ )



## Cost Function of Logistic Regression

$$\begin{aligned} \min_{\theta} \frac{1}{m} & \left[ \sum_{i=1}^m y^{(i)} \left( -\log h_{\theta} \left( x^{(i)} \right) \right) \right. \\ & \left. + \left( 1 - y^{(i)} \right) \left( -\log \left( 1 - h_{\theta} \left( x^{(i)} \right) \right) \right) \right] \\ & + \frac{\lambda}{2m} \sum_{j=1}^n \theta_j^2 \end{aligned}$$

## Cost Function of Support Vector Machine

$$\min_{\theta} C \sum_{i=1}^m \left[ y^{(i)} \text{cost}_1 \left( \theta^T x^{(i)} \right) + \left( 1 - y^{(i)} \right) \text{cost}_0 \left( \theta^T x^{(i)} \right) \right] + \frac{1}{2} \sum_{i=1}^n \theta_j^2$$

# Large Margin Intuition

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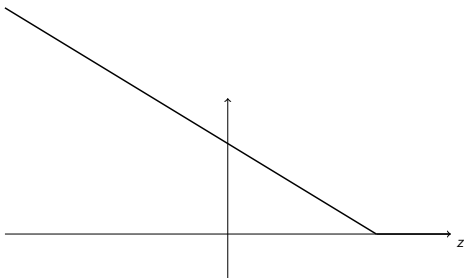
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## Support Vector Machine

$$\min_{\theta} C \sum_{i=1}^m \left[ y^{(i)} \text{cost}_1 \left( \theta^T x^{(i)} \right) + \left( 1 - y^{(i)} \right) \text{cost}_0 \left( \theta^T x^{(i)} \right) \right] + \frac{1}{2} \sum_{j=1}^n \theta_j^2$$



# Questions?